CLAIMS

1. An image interpolating device comprising:

an imaging device that has a light receiving surface on which pixels are disposed in a matrix arrangement, a subject image being formed on said light receiving surface to generate first color signals corresponding to said subject image in said pixels;

a first interpolation processor that performs a first interpolation process, using said first color signals generated in a plurality of adjacent pixels positioned adjacent to an objective pixel to obtain a second color signal of said objective pixel; and

a second interpolation processor that performs a second interpolation process using said second color signal of said objective pixel to modify at least one of said first color signals.

2. An image interpolating device comprising:

a color filter having a first row, in which red (R) and green (G) color filter elements are alternately aligned in the horizontal direction, and a second row, in which green (G) and blue (B) color filter elements are alternately aligned in the horizontal direction, said second row being adjacent to the upper or lower side of said first row;

an imaging device that generates first R, G, and B-signals which are pixel signals corresponding to said color filter elements;

a pattern-setting processor that extracts images belonging

to a first pattern, in which a pixel having said first R-signal is positioned at the upper-left corner of a 2 x 2 pixel matrix, a second pattern, in which a pixel having said first G-signal is positioned at the upper-right corner of said 2 x 2 pixel matrix, a third pattern, in which a pixel having said first G-signal is positioned at the lower-left corner of said 2 x 2 pixel matrix, and a fourth pattern, in which a pixel having said first B-signal is positioned at the lower-right corner of said 2 x 2 pixel matrix, from said first R, G, and B-signals generated by said imaging device;

a G-interpolation processor that, regarding first and fourth objective pixels contained in said images belonging to said first and fourth patterns, obtains a second G-signal by utilizing said first G-signals of pixels adjacent to said first or fourth objective pixel;

an R/B-interpolation processor that, regarding second and third objective pixels contained in said images belonging to said second and third patterns, obtains second R and B-signals by utilizing said first R and B-signals of pixels adjacent to said second and third objective pixels;

a first interpolation/modification processor that extracts a first similar pixel which has the closest luminance value to that of said first objective pixel, from pixels adjacent to said first objective pixel, obtains a third B-signal of said first objective pixel by a first interpolation process, and modifies said second G-signal and said first R-signal of said first objective

pixel, based on first information of said first similar pixel; and

a second interpolation/modification processor that extracts a second similar pixel which has the closest luminance value to that of said fourth objective pixel, from pixels adjacent to said fourth objective pixel, obtains a third R-signal of said fourth objective pixel by a second interpolation process, and modifies said second G-signal and said first B-signal of said fourth objective pixel, based on second information of said second similar pixel.

3. A device according to claim 2, wherein said first information comprises a luminance value and color difference signals Cb and Cr of said first similar pixel, and said second information comprises a luminance value and color difference signals Cb and Cr of said second similar pixel.

4. A device according to claim 2, wherein said first information comprises a first correction value corresponding to a rate of change of luminance values between said first objective pixel and said first similar pixel, and said second R, first G, and second B-signals of said first similar pixel, and said second information comprises a second correction value corresponding to a rate of change of luminance values between said fourth objective pixel and said second similar pixel, and said second R, first G, and second B-signals of said second similar pixel.

5. A device according to claim 2, wherein said pixels, which

are adjacent to said first and fourth objective pixels and which are utilized in said G-interpolation processor, are contained in said images belonging to said second and third patterns.

6. A device according to claim 2, wherein said pixels, which are adjacent to said second and third objective pixels and which are utilized in said R/B-interpolation processor, are contained in said images belonging to said first and fourth patterns.

7. A device according to claim 2, wherein said pixels, which are adjacent to said first and fourth objective pixels and which are utilized in both said first interpolation/modification processor and said second interpolation/modification processor, are contained in said images belonging to said second and third patterns.

8. A device according to claim 2, wherein said first interpolation/modification processor and said second interpolation/modification processor respectively extract said first and second similar pixels, using said first G-signals of said pixels adjacent to said first and fourth objective pixels.

9. A device according to claim 3, wherein said first interpolation/modification processor obtains said third B-signal and modifies said second G, and first R-signals, on the assumption that said color difference signals Cb and Cr of said first objective pixel are equal to said color difference signals Cb and Cr of said first similar pixel.

10. A device according to claim 3, wherein said second

interpolation/modification processor obtains said third R-signal and modifies said second G, and first B-signals, on the assumption that said color difference signals Cb and Cr of said fourth objective pixel are equal to said color difference signals Cb and Cr of said second similar pixel.

11. A device according to claim 3, wherein said first interpolation/modification processor obtains said third B-signal and modifies said second G, and first R-signals, using said color difference signals Cb and Cr and a modified luminance value which is obtained by multiplying said luminance value by a ratio of said second G-signal of said first objective pixel and said first G-signal of said first similar pixel.

12. A device according to claim 11, wherein said first interpolation/modification processor obtains said third B-signal and modifies said second G, and first R-signals, according to the following formula.

$$Y=0.299 \times R(x',y')+0.587 \times G(x',y')+0.114 \times B(x',y')$$

$$Cb=-0.169 \times R(x',y')-0.331 \times G(x',y')+0.5 \times B(x',y')$$

$$Cr=0.5 \times R(x',y')-0.419 \times G(x',y')-0.081 \times B(x',y')$$

$$YG=Y \times G(x,y)/G(x',y')$$

$$r'=YG+1.402 \times Cr$$

$$g'=YG-0.344 \times Cb-0.714 \times Cr$$

$$b=YG+1.772 \times Cb$$

wherein Y is a luminance value of said first similar pixel, R(x',y'), G(x',y'), and B(x',y') are said second R, first G, and second

B-signals of said first similar pixel, G(x,y) is said second G-signal of said first objective pixel, b is said third B-signal obtained by said first interpolation/modification processor, r' is said modified first R-signal, and g' is said modified second G-signal.

13. A device according to claim 3, wherein said second interpolation/modification processor obtains said third R-signal and modifies said second G, and first B-signals, using said color difference signal Cr and a modified luminance value which is obtained by multiplying said luminance value by a ratio of said second G-signal of said fourth objective pixel and said first G-signal of said second similar pixel.

14. A device according to claim 13, wherein said second interpolation/modification processor obtains said third R-signal and modifies said second G, and first B-signals, according to the following formula.

$$Y=0.299 \times R(x',y')+0.587 \times G(x',y')+0.114 \times B(x',y')$$

$$Cb=-0.169 \times R(x',y')-0.331 \times G(x',y')+0.5 \times B(x',y')$$

$$Cr=0.5 \times R(x',y')-0.419 \times G(x',y')-0.081 \times B(x',y')$$

$$YG=Y \times G(x,y)/G(x',y')$$

$$r=YG+1.402 \times Cr$$

$$g'=YG-0.344 \times Cb-0.714 \times Cr$$

$$b'=YG+1.772 \times Cb$$

wherein Y is a luminance value of said second similar pixel, R(x',y'), G(x',y'), and B(x',y') are said second R, first G, and second

B-signals of said second similar pixel, G(x,y) is said second G-signal of said fourth objective pixel, r is said third R-signal obtained by said second interpolation/modification processor, g' is said modified second G-signal, and b' is said modified first B-signal.

15. A device according to claim 2, wherein said first interpolation/modification processor extracts said first similar pixel, using said first G-signal and said second R-signal of said pixels adjacent to said first objective pixel.

16. A device according to claim 2, wherein said second interpolation/modification processor extracts said second similar pixel, using said first G-signal and said second B-signal of said pixels adjacent to said fourth objective pixel.

17. A device according to claim 3, wherein said first interpolation/modification processor obtains said third B-signal and modifies said second G-signal, and first R-signals, using said color difference signal Cb and a modified luminance value which is obtained by multiplying said luminance value by a ratio of a first reference value, which is obtained based on said second G-signal and said first R-signal of said first objective pixel, and a second reference value, which is obtained based on said first G-signal and second R-signal of said first similar pixel.

18. A device according to claim 17, wherein said first interpolation/modification processor obtains said third B-signal and modifies said second G, and first R-signals, according to the

following formula.

$$Y=0.299 \times R(x',y')+0.587 \times G(x',y')+0.114 \times B(x',y')$$

$$Cb=-0.169 \times R(x',y')-0.331 \times G(x',y')+0.5 \times B(x',y')$$

$$Cr=0.5 \times R(x',y')-0.419 \times G(x',y')-0.081 \times B(x',y')$$

$$YG=Y \times (0.587 \times G(x,y)+0.299 \times R(x,y))/(0.587 \times G(x',y')+0.299 \times R(x',y'))$$

$$r'=YG+1.402 \times Cr$$

$$g'=YG-0.344 \times Cb-0.714 \times Cr$$

$$b=YG+1.772 \times Cb$$

wherein Y is a luminance value of said first similar pixel, R(x',y'), G(x',y'), and B(x',y') are said second R, first G, and second B-signals of said first similar pixel, G(x,y) is said second G-signal of said first objective pixel, b is said third B-signal obtained by said first interpolation/modification processor, r' is said modified first R-signal, and g' is said modified second G-signal.

19. A device according to claim 3, wherein said second interpolation/modification processor obtains said third R-signal and modifies said second G, and first B-signals, using said color difference signal Cr and a modified luminance value which is obtained by multiplying said luminance value by a ratio of a first reference value, which is obtained based on said second G-signal and said first B-signal of said fourth objective pixel, and a second reference value, which is obtained based on said first G-signal and said second B-signal of said second similar pixel.

20. A device according to claim 19, wherein said second interpolation/modification processor obtains said third R-signal and modifies said second G, and first B-signals, according to the following formula.

$$Y=0.299 \times R(x',y')+0.587 \times G(x',y')+0.114 \times B(x',y')$$

$$Cb=-0.169 \times R(x',y')-0.331 \times G(x',y')+0.5 \times B(x',y')$$

$$Cr=0.5 \times R(x',y')-0.419 \times G(x',y')-0.081 \times B(x',y')$$

$$YG=Y \times (0.587 \times G(x,y)+0.114 \times B(x,y))/(0.587 \times G(x',y')+0.114 \times B(x',y'))$$

$$r=YG+1.402 \times Cr$$

$$g'=YG-0.344 \times Cb-0.714 \times Cr$$

$$b'=YG+1.772 \times Cb$$

wherein Y is a luminance value of said second similar pixel, R(x',y'), G(x',y'), and B(x',y') are said second R, first G, and second B-signals of said second similar pixel, G(x,y) is said second G-signal of said fourth objective pixel, r is said third R-signal obtained by said second interpolation/modification processor, g' is said modified second G-signal, and b' is said modified first B-signal.

21. A device according to claim 4, wherein said first interpolation/modification processor obtains said third B-signal and modifies said second G, and first R-signals, by adding said first correction value to each of said second B, first G, and second R-signals of said first similar pixel.

22. A device according to claim 4, wherein said first correction

value is obtained by multiplying said luminance value of said first similar pixel by a rate of change of G-signals between said first objective pixel and said first similar pixel.

23. A device according to claim 22, wherein said first interpolation/modification processor obtains said third B-signal and modifies said second G, and first R-signals, according to the following formula.

$$Y=0.299 \times R(x',y')+0.587 \times G(x',y')+0.114 \times B(x',y')$$

$$YG=Y \times (G(x,y)-G(x',y'))/G(x',y')$$

$$r'=YG+R(x',y')$$

$$g'=YG+G(x',y')$$

$$b=YG+B(x',y')$$

wherein Y is a luminance value of said first similar pixel, R(x',y'), G(x',y'), and B(x',y') are said second R, first G, and second B-signals of said first similar pixel, G(x,y) is said second G-signal of said first objective pixel, b is said third B-signal obtained by said first interpolation/modification processor, r' is said modified first R-signal, and g' is said modified second G-signal.

24. A device according to claim 4, wherein said second interpolation/modification processor obtains said third R-signal and modifies said second G, and first B-signals, by adding said second correction value to each of said second R, first G, and second B-signals of said second similar pixel.

25. A device according to claim 4, wherein said second correction

value is obtained by multiplying said luminance value of said second similar pixel by a rate of change of G-signals between said fourth objective pixel and said second similar pixel.

26. A device according to claim 25, wherein said second interpolation/modification processor obtains said third R-signal and modifies said second G, and first B-signals, according to the following formula.

$$Y=0.299 \times R(x',y')+0.587 \times G(x',y')+0.114 \times B(x',y')$$

$$YG=Y \times (G(x,y)-G(x',y'))/G(x',y')$$

$$r=YG+R(x',y')$$

$$g'=YG+G(x',y')$$

$$b'=YG+B(x',y')$$

wherein Y is a luminance value of said second similar pixel, R(x',y'), G(x',y'), and B(x',y') are said second R, first G, and second B-signals of said second similar pixel, G(x,y) is said second G-signal of said fourth objective pixel, r is said third R-signal obtained by said second interpolation/modification processor, g' is said modified second G-signal, and b' is said modified first B-signal.

27. A device according to claim 4, wherein said first correction value is obtained by multiplying said luminance value by a ratio of a first reference value, which is obtained based on said G-signals and said R-signals of said first objective pixel and said first similar pixel, and a second reference value, which is obtained based on said first G-signal and second R-signal of said first

similar pixel.

28. A device according to claim 27, wherein said first interpolation/modification processor obtains said third B-signal and modifies said second G, and first R-signals, according to the following formula.

$$Y=0.299 \times R(x',y')+0.587 \times G(x',y')+0.114 \times B(x',y')$$

$$YG=Y \times (0.587 \times (G(x,y)-G(x',y'))+0.299 \times (R(x,y)-R(x',y')) / (0.587 \times G(x',y')+0.299 \times R(x',y'))$$

$$r'=YG+R(x',y')$$

$$g'=YG+G(x',y')$$

$$b=YG+B(x',y')$$

wherein Y is a luminance value of said first similar pixel, YG is said first correction value, R(x',y'), G(x',y'), and B(x',y') are said second R, first G, and second B-signals of said first similar pixel, G(x,y) is said second G-signal of said first objective pixel, b is said third B-signal obtained by said first interpolation/modification processor, r' is said modified first R-signal, and g' is said modified second G-signal.

29. A device according to claim 4, wherein said second correction value is obtained by multiplying said luminance value by a ratio of a first reference value, which is obtained based on said G-signals and said B-signals of said fourth objective pixel and said second similar pixel, and a second reference value, which is obtained based on said first G-signal and second B-signal of said first similar pixel.

30. A device according to claim 29, wherein said second interpolation/modification processor obtains said third R-signal and modifies said second G, and first B-signals, according to the following formula.

$$Y=0.299 \times R(x',y')+0.587 \times G(x',y')+0.114 \times B(x',y')$$

$$YG=Y \times (0.587 \times (G(x,y)-G(x',y'))+0.114 \times (B(x,y)-B(x',y')) / (0.587 \times G(x',y')+0.114 \times B(x',y'))$$

$$r=YG+R(x',y')$$

$$g'=YG+G(x',y')$$

$$b'=YG+B(x',y')$$

wherein Y is a luminance value of said second similar pixel, YG is said second correction value, R(x',y'), G(x',y'), and B(x',y') are said second R, first G, and second B-signals of said second similar pixel, G(x,y) is said second G-signal of said fourth objective pixel, r is said third R-signal obtained by said second interpolation/modification processor, g' is said modified first G-signal, and b' is said modified second B-signal.